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## SCIENCE AND THE WOOLWICH AND SANDHURST EXAMINATIONS

IT will be known to most readers of NATURE that after 1884 considerable changes will be made in the various subjects in the examinations for admission to Sandhurst, and it is generally understood that an extension of similar changes to the examination for Woolwich is in contemplation. When these changes were announced, those interested in the matter at once saw that one of their chief effects would be to greatly discourage science teaching in our schools, &c., in consequence of the extremely low marks allotted to it under the new scheme. Representations were made on the subject at the War Office by the President of the Royal Society, and subsequently it was stated in the House of Lords, in reply to a question put by Lord Salisbury, that the final position of the subjects is still under consideration. As there is every reason to suppose that the object of the War Office authorities is to secure as good an examination as possible, and as they can have no possible reason for wishing to discourage scientific candidates only because they are scientific, it would seem that the present is a favourable opportunity for bringing the subject into public notice. The following are perhaps the most important points in connection with it:—

1. How far the choice of subjects made by the candidates has hitherto been affected by the marks allotted to them, and hence in what degree the new regulations or any similar regulations will influence science studies in our public schools.
2. How far it is true that science subjects have been good (?) cram subjects, since from the discussion in the House of Lords it appears to be considered by the War Office authorities that they have been good cram subjects.
3. To what extent the subjects examined and their grouping is at present satisfactory, and in what respects they would be better for amendment.
4. Whether the standard of the examination is, as has been urged by some, too high.

In the consideration of 1 and 2 the statistics of past examinations will give much help; 3 and 4 are, no doubt, to a greater degree matters of opinion.

I. As the result of tabulating the proportions of the successful candidates who have selected each subject in the competitions for entrance into Woolwich and Sandhurst during the years 1880, 1881, 1882, 1883, very interesting information has been arrived at, which is given in a condensed form in the tables below.

Only the selections made by successful candidates have been considered, for on the whole they will show best which subjects have been most conducive to success. And as the marks allotted to the subjects are different in the two examinations, they afford a good criterion by which to judge in what way marks have during the last four years affected the selection of subjects. Compulsory subjects are not included. The percentages relating to Woolwich are calculated from data which include all the examinations in the years 1830, 1881, 1882, 1883. Those

concerning Sandhurst are from data not quite so complete, but, as the larger tables from which these are taken exhibit considerable regularity, this is not of material importance.

		Mathe- matics	English	Latin	Greek	French	German	Experi- mental Science	Geography, Geology, &c.
SANDHURST	Marks allotted...	3000	3000	3000	2000	2000	2000	2000	2000
	Percentage of successful candidates taking the subject.....	70	91	73	22	91	25	8	19
WOOLWICH	Marks allotted...	4000	2000	2000	2000	2000	2000	2000	2000
	Percentage of successful candidates taking the subject.....	97	60	52	29	97	46	22	24

The influence of the maximum marks allotted to the subjects is perceptible at a glance. The increased marks given for mathematics in the Woolwich competition raises the proportion of those who take up that subject from 70 per cent. at Sandhurst to 97 per cent. at Woolwich. Similarly English and Latin are selected by 60 per cent. and 52 per cent. at Woolwich, where the maximum is 2000, against 91 per cent. and 73 per cent. at Sandhurst, where the maximum is 3000. And Greek, German, and Experimental Science are taking 29 per cent., 46 per cent., and 22 per cent. at Woolwich, where there is the same mark as for English and Latin, against 22 per cent., 25 per cent., and 8 per cent. at Sandhurst, where English and Latin have the higher mark of 3000, and the others only 2000. The positions of French is peculiar, but we observe the relatively better marks given in the Woolwich competitions has its effect, though there is less room for much increase. The selection of French by so large a proportion of the successful candidates both at Sandhurst and Woolwich, is probably largely due to the circumstance that it is taught in nearly all divisions of our schools, and that it is often begun earlier than Greek, German, and science, so that when candidates select the subjects they will study for these competitions, they already very often have made some progress in French and much less in the other subjects. Statistics, however, seem to show that French is more liberally marked than some of the others.

In the remaining subject, General and Physical Geography and Geology, there is a similar though smaller increase in the number of candidates taking it at Woolwich examinations, where its mark value is higher than at Sandhurst. This is just what the opinions of teachers have foretold. They say to do poorly in a subject counting 3000 will pay so much better than to do well in one counting only 1500, that in future nearly all candidates will take up the four subjects which are to count 3000; some who are very weak in one of these will take one of those marked 2000; and the rest of the subjects, including the science, they do not see their way to using at all. Accordingly, science teachers, even in those schools where science is most valued, are already hearing proposals to drop the regular science work hitherto done by boys who are looking forward to joining the army, and to substitute for it extra Latin. In other words, the new

regulations are already discouraging general education and encouraging an unfortunate system of specialisation.

II. The proportions of candidates who have chosen one of the branches of experimental science in these examinations show clearly that they are not generally regarded as paying subjects. At Sandhurst especially it is quite evident that there has been no considerable success in consequence of cramming in this subject. It has plainly not been worth while to cram it, nor to teach it for this examination, except in a few cases. At Woolwich under fairer conditions, it has been chosen by a greater number. Experience shows that in the Woolwich examinations candidates of real scientific ability who work well can do fairly, but only fairly, well, and accordingly such candidates are encouraged in those schools where science is taught to take up experimental science unless they are decidedly strong in some other subject. But the marks they get, even when successful, are not such as to encourage its adoption by any except those of a scientific ability quite above the average, and these do not want cramming. For example, a candidate standing second in order among the experimental science candidates lately obtained only 33 per cent. of the nominal maximum. And in one subject, chemistry, lads of such ability as would give them a fair chance of scholarships at our Universities had they time for sufficiently wide reading, will usually fail to get marks more than slightly exceeding 40 to 50 per cent. of the maximum, with the greatest diligence, even though their position on the list of experimental science candidates is a good one. These facts, and the absence of any rush on the subject seems quite inconsistent with the charge that experimental science has been a subject in which there has been much successful cramming—some there has no doubt been in this and in all subjects; candidates who have first-rate memories, and only moderate intelligence, will from time to time succeed by sheer industry in these and in all other competitions. Probably mathematics and experimental science suit these less than any other subject.

Geography, physical geography, and geology have been selected by rather more candidates both at the competitions for Sandhurst and Woolwich. From the nature of this subject it seems not impossible that there has been cramming in preparing for it. If so, the evil could surely be met, possibly by the changes proposed in Section III, combined with great care in setting the papers, and by the introduction of a *vivâ voce* examination.

III. As physiology is now extensively studied in the Universities, whence some of the Sandhurst candidates come, and is successfully taught in at least one great school—Eton—it is a question if the time has not come when it should be added to the science subjects examined.

And as practical physics is now taught in some schools, and examined at the scholarship competitions at Cambridge, it would be a gain if there could be a practical examination for candidates who take up physical subjects as there is for those who take up chemistry. This would act as a check on cramming, and would encourage students of a practical turn, and would encourage, as its absence discourages, this valuable branch of work in our public schools. One subject, chemistry, is encumbered by the addition of heat to it. Chemistry would be at least as difficult as the other divisions without this addition;

with it, and its practical examination, it is in a most unfair position. It would probably be advantageous to add light to heat, and make them a new division. The scheme would then stand as follows:—

DIVISION *a*.—*Experimental Science*

1. Chemistry. With a practical examination.
2. Light and Heat. " " "
3. Electricity and Magnetism. " " "

DIVISION *b*

1. Physiology. With some practical work.
2. Geography, Physical Geography, and Geology. With a *vivâ voce* examination on specimens.<sup>1</sup>

Candidates might be allowed to take one subject in Division *a* and one in Division *b*, which would be in accordance with the present plan at Woolwich, but would give greater choice of subjects. It would also be much fairer to one much-taught subject—chemistry.

IV. The very small proportion of the candidates for Sandhurst who select experimental science does suggest that in this case too high a standard is perhaps expected by the examiners, though it is probably a question of marks to a great extent. But with this exception, and if that very difficult subject, chemistry, were relieved of the addition of heat, on the whole it does not appear that the standard expected is much too high. It is true that there are other subjects marked more liberally; yet on the whole a high standard is more in the interests of science than a low one. The latter would encourage superficial teaching, and so lead to the discredit of the subject. Hitherto candidates of good scientific ability have been able to take advantage of their science at Woolwich if well taught, and if proper appliances for the work have been available. There does not seem therefore much ground for complaint on this score, though there has been a certain want of regularity in the marks awarded to similar boys in different subjects and at different examinations, which would probably be to a great extent removed if two papers instead of one were set on each subject, the papers being as far as possible of different characters. It has, however, been only just possible, even under the Woolwich system, for the scientific candidates to take up experimental science with the present standard of knowledge demanded, and a small difference in raising this standard or depressing the marks allotted to it would undoubtedly have very serious effects. The fairest method of allotting marks seems to be that adopted at Woolwich, where mathematics, which are essential, are marked above the rest, and the others are all upon an equal footing, free choice being allowed. To offer 3000 marks for four subjects, 2000 marks for two others, and 1500 for the rest, and to limit the candidates to four subjects, is equivalent to cutting out those for which 1500 are given, especially when it is a condition that of the four subjects selected three shall be taken from those for which 3000 marks are given, and only one at most from all the others. No doubt other plans which would be more satisfactory than that which has been employed at Woolwich could be suggested. But it is certain from past experience that a scheme of examination on the lines of the new regulations will seriously discourage the teaching of science in our public schools, and indeed will tend to narrow the instruction they give in all respects.

<sup>1</sup> Probably if the Geography were dropped and a higher standard of knowledge in the other two subjects were demanded, it would discourage superficiality, the Geography being retained in the preliminary examination, however, as a qualifying subject.